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THE
PHILOSOPHY
OF
EARTHQUAKES,
NATURAL and RELIGIOUS.

PART II,

Philosophi ipsius, qui de sua vi ac sapientia unus omnia pene profitetur est tamen quædam descriptio ; ut is qui studeat omnium rerum diuinarum atque humanarum vim, naturam, causasq; nosse : & omnem bene vivendi rationem tenere, & persequi ; nomine hoc appelletur.

Cicero de Oratore.

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P R E F A C E.

THIS discourse is but a necessary consequence of the preceding. The whole no other than an essay, toward investigating the true nature of the wonderful appearance of an earthquake. And something is done toward it, if only by eradicating an old error. In attaining the proposed end, I have endeavoured to lay all the necessary circumstances together, which to our great amazement we have seen and felt. That they may not be as soon forgotten, as they generally were, by the giddy multitude; equally thoughtless of what they knew to be past, as childishly fearful of an imaginary one, subsequent: for which there could not be the least ground of apprehension. By sober persons it was, with great reason, thought a judicial infatuation, and as much to be wondered at, as an earthquake itself; a real panic. When a third part of this immense city ran out into the fields for half a cold night; alarmed with the silly prediction of a distempered fellow!

Nothing could tempt one to commemorate the follies of our cotemporaries, but the hope, it may be useful hereafter: and to show the true cause of this senseless terror; the want of a true sense of

religion ; and an universal degeneracy, and corruption of manners : begun by the great ones, and now propagated through all degrees to the lowest : begun in this great city ; and now advancing apace to every great town in the kingdom.

'Tis from the great ones alone, that we can hope for a reformation : and that by a strict observance of the sabbatical duty. Example, we know, governs the actions of mankind. That must restore the practice, and the influence of religion : which alone can prevent the dangers that infest every corner of our streets ; every road in the kingdom. We mistake the point, and betray our ignorance in human nature, when we think, acts of parliament, laws, and executions will do it. They are very weak in comparison of the impressions of religion, and conscience : as all philosophy both natural and religious, has hitherto thought, and known.

T O

Martin Folkes, Esq; LL.D.
President of the Royal Society.

SINCE I had the honour to lay before the Society, in the spring, my thoughts upon earthquakes: we have had many further opportunities of reflecting upon that most awful, and hitherto unusual appearance. An earthquake was felt at *Eastwell* in *Kent*, on *Monday, March 12*, and on *Sunday, March 18*, at *Portsmouth*, the *Isle of Wight*, *Southampton*, and along the coast of *Sussex*, the isles of *Guernsey*, *Jersey*. *April 2*, a smart earthquake at *Manchester*, *Liverpool*, *Taunton*, *Bath*, *Flint*, *Lancaster*, *Wrexham*, reaching 40 miles north and south: 70 miles east and west. Since then at *Rome*, *Naples*, *Leghorn*; in the south of *France*; and at *Pau* under the *Pyrenean* mountains: *Oporto*, at *S. Macaire* in *Guinne*, *Messina* in *Sicily*, *Munich* in *Bavaria*, &c. &c. so that the year 1750, may rather be called the year of earthquakes, than of jubilee. For since *February* last, when they began with us at *London*; as far as I can learn, they have

appeared in many parts of *Europe, Asia, Africa,* and *America.* And have likewise revisited many counties in our own island, and at length, on the 30th of last *September* gave much the most extensive shock, we have seen here in our days.

It may be well expected, that these frequent visits, in themselves so very extraordinary, to us so rare, and *that* in one year, should keep up our attention: and as to my own part, induce one to reflect, on what I before offered concerning them; and be a sufficient apology for the present paper.

We have been acquainted, by those who remember it, that in the earthquake of Nov. 1703, which happened in *Lincolnshire*, the weather was calm, close, gloomy, warm, and dry; in a degree highly unusual, at that season. And thus it has been with us all the year. And from the numerous accounts we have received at the Royal Society, in the beginning and ending of the year; where any mention is made of the weather; they all agree in the like particular. Which is consentaneous to what I remarked, as the constant forerunner of earthquakes; and what prepares the earth's surface, for the electrical stroke: which I asserted to be the cause of them.

In May last, we had a paper read at the Royal Society, concerning the second earthquake felt by us at *London*, on the 8th of *March*. A shepherd belonging to Mr. Secretary *Fox* at *Kensington* (the sky being perfectly serene, and clear) was much surprised with a very extraordinary noise in the air, rolling over his head, as if cannon close by. He likewise thought, that it came from the north-west, and went to the south-east: a motion quite contrary, to what must have been the case, if it were really of cannon. This noise passed rushing by him; and instantly he saw the ground (a dry, and solid spot) wave under him, like the face of the river. The tall trees of the avenue, where he was, nodded their tops very sensibly, and quivered like a shaken spear. The flock of sheep immediately took fright, and ran all away together, as if dogs had pursued them. A great rookery in the place, were equally alarmed, and after an universal clangor, flew away; no less than if chaced by hawks.

I was likewise informed, that in the same earthquake, a great parcel of hens, and chickens, kept at that time in *Grays-inn-lane*, upon the shock, ran to the roost, affrighted. And the like was observed of pigeons. And in our last account of the earthquake from *Northampton*, 'tis remarked, that the birds in cages put

their heads under their wings, as to hide themselves.

June 21, at the Royal Society, Mr. Jackson, potter at Lambeth, gave an account of some boats, cobles, and lighters in the river, at that time; the people in them seem'd to feel, as if a porpoise, or some great fish had heav'd and thump'd at the bottom of the vessels. This is sometimes the case of ships at sea, when all is perfectly calm: which seems evidently owing to an electrical impression on the water.

In the Whitehall Evening-post of June 23, we had a paragraph from *Venice*, that a terrible earthquake had been felt lately in the little rocky isle of Cerigo, in the *Mediterranean*, south of Morea. It threw down a great number of houses; and above 2000 of the inhabitants were buried in the ruins.

Another earthquake about that time, happened in *Switzerland*; which split a vast rocky mountain; and an old castle wall of an immense thickness.

All these circumstances, and many more, confirmed me in my former opinion. But since then, these wonderful movements have stalk'd round the globe: and again been lately felt in our own island; happily for us, to the terror only of many thousand people: beside those concussions of this sort that appeared in the

western parts, in the more early time of the year.

I received a letter from my friend *Maurice Johnson*, Esq; the founder, and secretary of the Literary Society of *Spalding*: which has now subsisted these 40 years. He acquaints me, that on *Thursday, 23d of August* last, an earthquake was very sensibly felt there, about seven o'clock in the morning; throughout the whole town and neighbourhood; and many miles round: but that it chiefly spread itself northward, and southward. He says, that for a fortnight before, the weather had been serene, mild, and calm. And one evening, there was a deep red *aurora australis*, covering the cope of heaven, very terrible to behold. This same shock was felt at *Grantham*, *Stamford*, and *Milton by Peterborough*; and generally at all the intermediate places: and from *Spalding* it fled northward, along the sea shore, to *Boston*: thence up *Boston river*, to *Lincoln*.

Since then, I had a letter from Mr. Alderman *Taylor* of *Stamford*, giving an account of another earthquake, that happened there, *September 30*, at 36 minutes after twelve o'clock at noon. He describes it thus. They were suddenly surprised with an uncommon noise in the air, like the rolling of large carriages in the streets, for about 20 seconds. At the same instant

stant they felt a great shake, or snap, as he calls it; insomuch that it sensibly shook a punch-bowl, which was in his parlour, and made it ring. He says, it was perceiv'd of most of the people of *Stamford*, who generally ran out of their houses. At *Oakham* the chief town of *Rutland*, the congregation ran out of the church whilst the preacher was in the pulpit. All the towns round *Stamford*, were sensible of it: and at *Peterborough*, down to *Wisbech*.

Thus far the Alderman. But we have had many advices from all hands, at the first, and second meetings of the Royal Society, for the winter-season; with further particulars relating to this great concussion. That it was felt at the same time, at *Rugby* in *Warwickshire*, and reach'd to *Warwick*, at *Lutterworth*, in *Leicestershire*: at *Leicester*, and round about. It extended itself to *Coventry*, *Derby*, *Nottingham*, *Newark*; then came eastward to *Harborough*, *Towcester*, *Northampton*, *Rowel*, *Kettering*, *Wellingborough*, *Oundle*, in *Northamptonshire*; *Uppingham*, *Oakham*, in *Rutland*; *Stamford*, *Bourn*, *Grantham*, *Spalding*, *Boston*, and to *Lincoln* in *Lincolnshire*; *Holbeck*, and all *Holland* in that county. *Peterborough*, *Wisbech*, in the isle of *Ely*; together with all the intermediate, and adjacent places. Then it pass'd over the whole breadth of *Ely* fen: was felt at *Mildenhall*, and reach'd

reach'd to *Calford* by *Bury* in *Suffolk*, and the country thereabouts; of which we had notice from lady *Cornwallis*. An extent from *Warwick* to *Bury* of about 100 miles in length; and generally speaking, 40 miles in breadth. And this vast space was pervaded by this amazing motion, as far as we can get any satisfaction, in the same instant of time. They describe it, that the houses totter'd, and seem'd to heave up, and down: though it lasted but a few seconds. It was attended with a rushing noise, as if the houses were falling, and people were universally so affrighted, as to run out; imagining that their own, or their neighbours houses were tumbling on their heads. In the villages around, the people being generally at divine service, were much alarm'd: both with the noise, which exceeded all the thunder they had ever heard, beyond compare: and with the great shock accompanying; which was like somewhat, as they imagined, that rush'd against the church-walls, and roof. Some thinking the pillars crack'd, many that the beams of the roof were disjointed; and all, that the whole was falling. And happy were they that could get out first. Many people fancied, that nests of drawers, and cabinets, or the like heavy things, were fallen down above stairs: or that chimnies had broke through the roof of the house:

house: or that some persons fell down stairs: and the like. Some perceived the crackling of inward wainscots or partitions: as Dr. *Mortimer* and I observ'd in our first and second shocks at *London*. A few slates, tiles, and parts of chimnies fell from some houses: pewter, china, glasses, and brass from shelves. A clock bell, chamber bell some time struck: windows universally rattled, and the like circumstances of tremor.

In regard to circumstances, they were pretty similar throughout. Many people sitting in their chairs relate, that they and their chairs were several times sensibly lifted up and set down again. A stack of chimnies were thrown down in *College-lane*; a place retaining the memory of a sort of university once beginning at *Northampton*. The windows of houses rattled throughout the whole town: but no mischief done: in general it was frightful, and innocuous.

They fancied there, the motion of it, as they expressed it, to be eastward. In streets that run north and south, the houses on the east side of the way, were most affected. And Dr. *Stonehouse's* dwelling, the strongest in the town, was most sensibly shaken. So it was likewise observed; that churches were most subject to its violence. They thought too, that the mo-

tion seemed rather horizontal, or lateral, than upward. Some counted the pulses distinctly, to the number of four : that the second, and third pulses were stronger, than the first, and fourth.

From all these various accounts, there was no sulphureous smell, or eruption ; no fissures in the ground perceived. Yet several people were sick upon it : infinite numbers terribly affrighted, and as soon forgot the impression of it ; or talk'd of it in a merry strain ; as commonly with us at *London*. So little are the vulgar affected, without something very sensible ; and so soon is the sense of it worn out !

It was more evidently perceived, by people standing ; most, by those that were sitting : least, by such as were walking : and in upper stories of houses, more than in lower ; or in cellars. Some coming down stairs, were in danger of being thrown forwards. Several sitting in a chair, and hearing the hollow thundering noise, and thinking it was a coach passing by ; when they attempted to get up, to see what it was, they were thrown back again in their chair. Some heard the wainscot crackle. Some sitting in their chairs leaning forwards, were thrown down on their hands and knees. Some people heard the noise without feeling the shock : others felt the shock without hearing

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ing the noise. Some in a standing posture, were forced to lay hold on a table, to keep themselves from falling.

It was particularly remarked (as before observed) that birds in cages were sensibly affrighted; thrusting their heads under their wings. Mrs. *Allcock* of *Loddington, Northamptonshire*, a lady in child-bed, was so affected, that it caused her death. Mrs. *Hardy*, another lady in the same circumstance, and in the same county, likewise expired upon it. Some people felt a sudden shortness of breath, that they were forc'd to go out into the open air, it so affected the pulmonary nerves. Many were taken with head-achs, and other sicknesses.

These are, in general, the circumstances and observations made, at the time of these earthquakes; when we recollect ourselves, after the suddenness, and fright. Give me leave to make the following remarks therefrom.

1st. As far as we can possibly learn, where no one can be prepar'd, at different places, by time keepers; this mighty concussion was felt precisely at the same instant of time; being about half an hour after twelve at noon. This, I presume, cannot be accounted for, by any natural power, but by that of an electrical vibration; which, we know, acts instantaneously.

2dly,

adly, Let us reflect on the vast extent of this trembling, 100 miles in length, 40 in breadth, which amounts to 4000 square miles in surface. That this should be put into such an agitation, in one moment of time, is such a prodigy; as we should never believe, or conceive, did we not know it to be fact, from our own senses. But if we look for a solution of it, we cannot think, any natural power is equal to it, but that of electricity; which acknowledges no sensible transition of time; no bounds.

3ly, We observe the vulgar solution of subterraneous eruptions receives no countenance, from all that was seen, or felt, during these earthquakes. It would be very hard to imagine, how any such thing could so suddenly, and instantaneously operate, thro' this vast space; and *that* in so similar, and tender a manner over the whole, thro' so great a variety, as well as extent of country; as to do no mischief. A philosophical inquirer in *Northamptonshire*, who had his eye particularly on this point, takes notice, there were not any fissures in the ground; any sulphureous smells, or eruptions any where perceiv'd; so as to favour internal convulsions of the earth. The reverend Mr. *Nixon* of *Higham*, and Mr. *Smith*, in his letter from *Peterborough* take notice, that they could not learn, there were any sort of eruptions out of the earth,

earth, any where: no smoke, vapor, or smell? tho' they made sufficient inquiry about that circumstance, according to particular direction. Yet we learn from a letter at *Uppingham* in *Rutland*, that a plaister floor became crack'd thereby. These kind of floors are frequent in this country; what we call *stucco* in *London*: and it gives us a good notion of the undulatory vibration, produc'd by an earthquake; which some have compar'd to that of a musical string: others to that of a dog, or a horse shaking themselves, when they come out of the water. This last comparison would have pleased some of the ancients, who would needs fancy, that the globe of the earth was a great animal. *Plato*, *Phytarch*, and others, had such kind of sentiments. Whence one may imagine, that they would conceive an earthquake to be, as when a horse shakes a part of his skin, upon a fly touching him. Some of our correspondents express the motion of an earthquake to be like a boat lifted up by one wave, let down by another.

4ly, The former earthquake that happen'd at *Grantham*, *Spalding*, *Stamford*, (which towns lie in a triangle) took up a space which may, in gross, be accounted a circle of 30 miles diameter: the center of which is that great morass, called *Deeping-fen*. This comprehends 15 miles of that 30, in diameter: and where probably,

bably, the electrical impression was first made. Much the major part of *Deeping-fen* is under water in the winter time; underneath 'tis a perfect bog. Now it is very obvious, how little favorable such ground is, for subterraneous fires.

In the second earthquake, not only this country was affected again, but likewise a much larger space of the same sort of fenny ground, rather worse than the former: all *Donnington-fen*, *Deeping-fen*, *Croyland-fen*, *Thorney-fen*, *Whittlesea-fen*, and *Bedford* level, and the whole extent of *Ely-fen*, under various denominations. This country, under the turf, abounds with subterraneous timber of all sorts; fir, oak and brush-wood: and stags horns. Now and then they find a quantity of hazel nuts, crowded together on an heap. I have some of them. This is a matter common to all boggy ground over the whole globe. Such things are the ruins of the *antediluvian* world, washed down from the high country where they grew, were here lodg'd upon the subsiding of the waters, and by time are o'ergrown with the present turf. They that seek for any other solution of this affair, than the universal *Noachian* deluge, want to account for a general effect, by a partial cause: and shut their eyes, both to the plain history of this matter; and to the infinite, notorious demonstrations of it, from fossil appearances.

gly, All this country, tho' underneath 'tis a watry bog, yet thro' this whole summer, and autumnal season (as they can have no natural springs in such a level) the drought has been so great on the superficies, that the inhabitants were obliged every day, to drive their cattle several miles, for watering. The drought was greater, than has been known in the memory of any one living. This shows how fit the dry surface was, for an electrical vibration. And we learn from hence, this important particular, that it reaches but very little below the earth's surface.

Mr. *Johnson*, in another letter which he wrote to me concerning the second earthquake observed at *Spalding*; says upon this occasion, he was obliged to scour his canal, and deepen it : that they came to a white quicksand ; which afforded to all the neighbourhood, excellent water in plenty.

In the gravelly foil of *London*; and where the two shocks were felt by us, in the beginning of the year; we know there is not a house in the whole extent of this vast city, and all aronnd it, but a spring of water is ready, upon digging a well. Whence we have much reason to believe, that the interior of the earth, is like a sponge soak'd in water. So that the only dry part is the superficies, which is the object,

object, and the subject of that electric vibration; wherein, according to my sentiments, an earthquake consists.

This shews the mistake of the ancients, who fancying that earthquakes proceeded from subterraneous eruptions, built their prodigious temple of *Diana* at *Ephesus*, upon a boggy ground, to prevent such a disaster. The marshy part of *Lincolnshire*, being my native country, the adjacent fen, together with that of the isle of *Ely*, I have been perfectly acquainted with; from one end to the other, ever since I knew any thing. This vast extent of fenny level, from near *Cambridge* in the south, to near *Horn-castle* in the north, is 70 miles in length. And when I perceiv'd, that it was, in whole, or in part, shaken by both the last earthquakes: I could not but see, that it was no less than a demonstration against the old notion of their cause.

6ly, Earthquakes are truly most violent in a rocky country: because the shock is proportionate to the solidity of the matter electrify'd. So that rocks, cliffs, quarries, old castle walls, and strong buildings, are most obnoxious to the concussion. The isle of *Cerigo* was more liable, and more rudely handled by the late earthquake; both because it was an isle, and because it was rocky. So we must say of the

late earthquake in Switzerland, that split the mountain, and the old castle wall. Whence Mr. Johnson in his second letter says, it crack'd a very strong brick-house in Gosberton by Spalding. Dr. Doderidge observes from Northampton, that Dr. Stonehouse's dwelling being a very strong one, was most sensibly shaken. And throughout the whole compass of this great earthquake, we find, both the noise, the shock, and the terror was greatest at the churches, whose walls and bulk made more resistance than houses. And generally speaking, the churches throughout this whole extent have very fair and large towers, and very many remarkable spires all of good stone, which no doubt quivered very much at top, if we could have discern'd it. This same vibration impressed on the water, meeting with the solid of the bottom of ships, and lighters, gives that thump felt thereon; just as in common electrifying, we feel the stroke upon the joints of our limbs chiefly. Yet of the millions of ordinary houses, over which it passed, not one fell. A consideration which sufficiently points out to us, what sort of a motion this was not, what sort of a motion it was, and whence derived; not a convulsion of the bowels of the earth, but an uniform vibration or undulation of its surface, aptly thought like that of a musical

fical string: or what we put a drinking glass into, by rubbing one's finger over the edge; which yet brought to a certain pitch, breaks the glass; undoubtedly an electric repulsion of parts. And from this remarkable similarity in the appearance of earthquakes we gather an invincible argument against the old opinion of their cause; for the tumult of subterraneous eruptions can have no possible place herein.

7ly, We find from all accounts, ancient and modern, that the weather preceding these shocks, was mild, warm, dry, serene, clear, frosty: what notoriously favours all our electrical experiments. This is particularly observ'd by Mr. *Johnson* and Mr. *Smith*, and other accounts. In the extensive shock of *Sunday March 18*, along the *Sussex* coast, they take notice from *Portsmouth*, that the day was serene, warm, and dry, and that a shower of rain fell immediately before the shock. Mr. *Bowman* of *Moulsey* observ'd a shock there on *May 24* last, and says, the air was perfectly serene, and clear. We very well know, that generally, all last winter, spring, summer, and autumn, have been most remarkably of this kind of weather; more so, than has been observ'd in our memory; and have had all those requisites, appearances, and preparations, that notoriously cause electricity, that promote it, or that are the effects of it.

sly, We find the blood-red *australis aurora* preceding at *Spalding*, as with us at *London*. At the time of the earthquake at *Manchester* this year, it accompanied it. And this year has been more remarkable than any for fire-balls, storms, wind, thunder, lightnings, and coruscations, almost throughout all *England*. A large ball of fire, with a long fiery tail on *July 22*, that passed over great part of *England* northward. Another seen over *London*, passing from west to east, in *October*. Coruscations were seen just before that extensive shock of 70 miles long felt from *Lancaster* to *Wrexham*, on *April 2*, last. Fire-balls more than one were seen in *Rutland*, and *Lincolnshire*: and particularly obsery'd. And Mr. *Smith* from *Peterborough* writes, that a fire-ball was seen the morning of the earthquake, in the upper part of *Northamptonshire*. All these kind of meteors are rightly judg'd to proceed from a state of electricity in the earth and atmosphere: and how far they are actually concerned in causing earthquakes, time, and accurate observation must inform us.

gly, Mr. *Johnson* in both his letters to me, on the first and second earthquakes, at *Spalding*, remarks particularly, of their effects being mostly spread to the north and south, and especially felt on the sea coast. We may observe,

serve; that such is the direction of *Spalding* river, which both conducts, and strengthens the electric vibration: conveying it along the sea-shore thence, up to *Boston* channel; and so up *Boston* river to *Lincoln*, as we discern, by casting our eye on a map.

We observe further, that the main of this second earthquake display'd its effects along, and between the two rivers, *Wolland* and *Avon*: and that from their very origins, down to their fall into the sea. It likewise reach'd the river *Witham*, which directed the electric stream that way too, to *Lincoln*. For which reason, as there meeting the same coming from *Boston*, the shock was most sensibly felt. It reach'd likewise to the *Trent* at *Nottingham*, which convey'd it to *Newark*.

The first electrical stroke seems to have been made on the high ground above *Daventry*, in *Northamptonshire*; where the *Roman* camps are, made by *P. Ostorius* the proprætor. From thence it descended chiefly eastward, and along the river *Welland*, from *Harborough* to *Stamford*, *Spalding*, the sea: and along the river *Avon*, or *Nen*, to *Northampton*, *Peterborough*, *Wisbech* to the sea. It spread itself all over the vast level of the isle of *Ely*; further'd by very many canals, and rivers, natural, and artificial, made for drainage. It was still conducted

eastward up *Mildenhall* river, in *Suffolk*, to *Bury*, and the parts adjacent. All this affair duly consider'd, is a confirmation of the doctrine I advanc'd on this subject.

I only, I apprehend, it was not the noise in the air, as of many cannon let off at once, preceding the earthquake; that so much affrighted people, or affected the sheep, the rookery at *Kensington*, the hen and chickens in *Gray's-inn-lane*, the pigeons. It could not be barely the superficial movement of the earth, that disturb'd them all at once. I judge it to be the effect of electricity, somewhat like what causes sea sickness ; such a sort of motion, as we are not accustomed to. So the earthquake affects all those of weak nerves, or that have nervous complaints ; obnoxious to hysterics, colics, rheumatic pains in their joints ; several women were seized with violent head-achs, before both the shocks we felt in *London*. It was this that gave the people a shortness of breath. Mr. *Smith* from *Peterborough* speaks of a person that found himself very sick upon it. This made the dog run whining about the room, seeking to get out : this made the fishes leap up in the pond at *Southwark* ; like as the experiment of electrifying the fishes : it makes them sick. And this causes the birds in cages to hide their heads under their wings, because they cannot

cannot fly away. Which is commonly observ'd of them in *Italy*, and countries, where earthquakes are more frequent.

I Ily, I observe, the Shepherd at *Kensington* thought the motion of the earthquake, and the sound, was from the north-west to south-east: the like Mr. *W. Smith* from *Peterborough*. On the contrary, Mr. *Byfield* the scarlet-dyer in *Southwark*, thought the noise came from the river below bridge, and went toward *Westminster*; where it rattled so, that he did not doubt, but that the abbey church was beaten down.

Dr. *Parsons* took pains to find out the way of the motion of the earthquake, from the different position of people's beds; but from the contradictory answers given, he cou'd not obtain any satisfaction, as to that point. All this, and what was observ'd from *Northampton*, of the motion being thought by some, to be upward and downward; by others rather horizontal, or lateral: the counting the pulses, and the like, only points out to us the prodigious celerity, and the vibratory species of the motion of an earthquake. But far, very far is this from being owing to the tumultuous ebullition, the irregular hurry of subterraneous explosions.

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12ly, How the atmosphere, and earth, are put into that electric and vibratory state, which prepares them to give, or receive the snap, and the shock, which we call an earthquake ; what it is, that immediately produces it, we cannot say : any more than we can define, what is the cause of magnetism, or of gravitation ; or how muscular motion is perform'd, or a thousand other secrets in nature.

We seem to know, that the author of the world has disseminated ethereal fire, thro' all matter, by which these great operations are brought about. This is the subtil fluid of Sir Isaac Newton, pervading all things : the occult fire diffused thro' the universe, according to Marsilius Ficinus the platonick philosopher, on the *Timeus* of his master. All the Platonists insist on an occult fire passing thro', and agitating all substance, by its vigorous and expansive motion.

Before them, Hippocrates writes in the same sense, *I. de victus ratione*, that this fire moves all in all. This ethereal fire is one of the four elements of the ancients. It lies latent, and dispersed thro' all the other three, and quiescent : till collected into a quantity, that overbalances the circumjacent ; like the air crowded into a tempest : or till it is excited, by any proper motion..

This

This fire gives elasticity : and elasticity or vibration is the mother of electricity. We don't so much wonder at phosphorus arising from animal substances ; for this fire is in water, and betrays itself to our senses, in salt water. Many a time when I have pass'd the *Lincolnshire* washes, in the night time ; the horse has seem'd to tread in liquid flames. The same appearance is oft at the keel of a ship. Fire exists in water, says *Pliny*, as well as in human bodies. *nat. hist.* II. 107. Loaf sugar beaten in the dark is luminous. Many vegetables, as indian cane, and rotten wood the like, as *Bartholin* largely recites, *de luce hominum* c. 4. All electric bodies have this privilege : that is, they more easily discover it. Amber, gum lac, naptha, bitumens, some precious stones. My old friend Mr. *Stephen Gray* the father and great propagator of electricity, show'd me experiments therein, in the year 1705, then at *Corpus Christi* college in *Cambridge*. Afterward in 1719, he show'd by experiments before the Royal Society, that paper, ribbands, silk, satin, cloth, shavings, linen, goldbeaters skin, and in short, almost all kind of substances discover electrical sparks of fire in the dark : especially when well warm'd before the fire, or in a cold, dry, nitrous air, and in a room where there is no company. This same quality

lity is found *in vacuo*, as Dr. *Desaguliers* shew'd before the Royal Society, *march 31, 1720.* He took an exhausted glass globe, and caused it to be turn'd round violently, in an engine: by rubbing the hand upon it, it was illuminated within side, with purple streams. This gave foreigners the idea of using a glass globe, in electrical experiments.

The operation of the ethereal fire is various, nay, infinite, according to its quantity, and degree of incitement, progress, hindrance, or furtherance. One degree keeps water fluid, says the learned bishop of *Cloyne*: another turns it into elastic air, and air itself seems nothing else, but vapors, and exhalations render'd elastic, by this fire.

This same fire permeates, and dwells in all bodies; even diamond, flint and steel. Its particles attract with the greatest force, when approximated. Again, when united, they fly asunder, with the greatest force, and celerity; it resists nothing quiescent, but when put into motion, it disdains all resistance. All this is according to the laws prescrib'd by the sovereign architect. This is the life and soul of action, and reaction, in the universe. Thus has the great author provided against the native sluggishness of matter! light, or fire in animals, is what we call the animal spirits; and is the au-

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thor of life, and motion. But we know not the immediate mode of muscular motion ; any more than how, in inanimate matter, it causes the vibrations of an earthquake.

Of this fire, the excellent *Manilius* thus writes, who liv'd in the time of *Augustus*.

Astronom. I.

*Sunt autem cunctis permisi partibus ignes ;
Qui gravidas habitant fabricantes fulmina nubes :
Et penetrant terras, Aetnamq; imitantur Olympo :
Et calidas reddunt ipsis in fontibus undas.*

*Ac silice in duro, viridiq; in cortice sedem
Inveniunt ; cum silva sibi collisa crematur.
Ignibus usq; adeo natura est omnis abundans !*

Which may thus be english'd.

Fire universal nature traverses.
It makes the thunderbolt in tumid clouds :
In dire Vulcano's penetrates the earth :
And sends the boiling water from its springs.
In hardest flint, and softest wood it dwells :
Which by collision shows itself in flame.
With fire so pregnant is all nature found !

13ly, The great question then with us, is how the surface of the earth is put into that vibratory and electric state, by heat and dryness ? we must needs acquit the internal of the earth from the charge of these superficial concussions.

cussions. How then is the ethereal fire crowded together, or excited, so as to cause them ; seeing in our ordinary electrical experiments, we make use of friction ?

But that friction alone does not excite electricity, we know from the obvious experiment of flint and steel, where the suddenness of the stroke, and hardness of the matter does it. Another method of exciting it, is the letting off a number of great guns, which so crowds the ethereal fire together, as to electrify glass windows ; observ'd by my friend the reverend Dr. *Stephen Hales*. The *aurora borealis, australis*, all kind of coruscations, meteors, lightning, thunder, fire-balls are the effects, and may reciprocally be the cause of electricity ; but how in particular we know not. Come we to the animal world, we must needs assert, that all motion voluntary, involuntary, generation, even life itself : all the operations of the vegetable kingdom, and an infinity more of nature's works, are owing to the activity of this electric fire, the very soul of the material world. And in my opinion, 'tis this alone, that solves the famous question, so much agitated with the writers in medicine, about the heat of the blood. How these, how earthquakes are begun, propagated, we are yet to seek.

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We may readily enough presume, that the contact between the electric, and the non-electric, which gives the snap, and the shock, must come from without, from the atmosphere. Perhaps by some meteor that crowds the ethereal fire together: which then flies off with that immense force that causes the earthquake. In the point of contact on the earth's surface, the same thing is done, perhaps, another time, by a shower of rain. Our thoughts upon this matter must needs be as immature, as they are novel. But we may readily conclude, that tho' the original stroke comes from the atmosphere, yet the atmosphere has no further concern in it: no aereal power, or change therein, can propagate itself so instantaneously, over so vast a surface, as 4000 miles square. Therefore the impetuous rushing noise in the air, accompanying the shock, is the effect, and not the cause. And all this is strongly confirmed by this observation, that the barometer and thermometer received no change upon the earthquakes.

But surely, there is not a heart of flesh that is not affected with so stupendous a concussion! let a man estimate his own power, with that which causes an earthquake; and he will be persuaded, that somewhat more than ordinary

is intended by so rare and wonderful a motion. That great genius *Hippocrates*, makes the whole of the animal œconomy to be administred, by what we call nature. And nature alone, says he, suffices for all things, to animals: she *knows* herself, and what is necessary for them. We must extend this thought to the inanimate world. And can we deny then, that he here means a conscious and intelligent nature, that presides over, and directs all things, moves the ethereal spirit or fire, that moves all things: a divine necessity, but a voluntary agent, who gives the commanding nod, to what we commonly call nature; the chief instrument in the most important operations of the vast machine, as well as in the ordinary ones, particularly the human one: administering the whole œconomy (as he says) without noise, unseen, unfelt. And this leads us,

Lastly, in regard to the spiritual use we ought to make of these extraordinary *phænomena*, or of our inquiries about them, I shall first observe, that we find abroad, several of these earthquakes this year have been very fatal. In the last we read of, at *Philippopolis* in *Thrace*, the whole city was destroyed, above 4000 inhabitants killed. At home, where above half a score separate concussions have been felt,
there

there has not been one house thrown down, one life lost. This ought to inspire us with a very serious reflection about them; nor is it altogether unworthy of our remark, that they began with us in *London*, in *February* last: and after visiting the circle of the globe, at present, end with us.

2dly, We may observe, that if we did but read the works of *Hippocrates*, *Plato* and his followers; of *Tully*, *Galen*, and the like ethic writers of antiquity; whilst we study, and try the affections of matter; we should improve in philosophy, properly speaking: we should lift up our minds from these earthly wonders, and discern the celestial admonitions, they present to us.

The original meaning of the word philosophy, was rightly apply'd to moral wisdom. We who have advanced both the natural, and moral, should, as the ancients did, join them both together. By this means, we gather, the truth of the highest, and most excellent philosophy, to be found in those volumes of first antiquity, which we call sacred: and which, it is our peculiar, and inestimable happiness to possess. We should adore that divine light, which they hold forth to us. Especially in a country, where the principles of true religion

are open, and undisguised: where the established profession of it is rational, noble, and lovely: worthy of the moral governor of the world; fit for him to enjoin: for us to practise, with pleasure and effect.

November 7, 1750.

W. STUKELEY.

Read at the Royal Society, *December 6.*

